PA1.15: RCED-90-171

United States General Accounting Office

GAO

Report to the Honorable
Vic Fazio, House of Representatives

COMPLETED
12

June 1990

NUCLEAR R & D

Usefulness of Information From Shippingport Decommissioning for Rancho Seco

GAO/RCED-90-171

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-239632

June 7, 1990

The Honorable Vic Fazio
House of Representatives

Dear Mr. Fazio:

At a December 7, 1989, meeting, we agreed to provide you with information related to decommissioning the Rancho Seco, California, nuclear power plant.[1] Specifically, we are providing information on the following:

- lessons learned from the Department of Energy's (DOE) decommissioning of the Shippingport, Pennsylvania, nuclear power plant and the usefulness of this information to Rancho Seco and the commercial nuclear power industry in general; and
- additional questions that could be answered if DOE funded a research project as part of the decommissioning activities for Rancho Seco.

The Nuclear Regulatory Commission (NRC) has issued licenses to 55 utilities for 113 commercial plants. At the end of their useful lives, utilities must decommission the plants. Under NRC's regulations, utilities can take up to 60 years to complete these activities. However, Shippingport was not licensed by NRC. Rather, DOE and the Duquesne Light Company had a contract sharing ownership of the plant and requiring DOE to decommission the plant at the end of its useful life. DOE does not have a similar obligation for Rancho Seco or other commercial plants.

The Sacramento Municipal Utility District (SMUD) shut down Rancho Seco in June 1989 in response to a voter referendum. Although SMUD is developing a decommissioning plan that should be completed around July 1990, company officials told us that they may wait 20 to 30 years before they begin to physically decommission the plant. The information that we are providing on Shippingport was originally requested by the Chairman and Ranking Minority Member, House Committee on Science, Space, and Technology. A more detailed report on Shippingport will be issued to that Committee at a later date.

[1]Decommissioning includes reducing and/or removing radioactive contamination from buildings, equipment, and facility sites to a level that allows the property to be used for any purpose.

Results in Brief

DOE's activities at Shippingport increased the base of knowledge for decommissioning commercial nuclear power plants. However, the lessons learned may diminish by the time a large number of utilities decommission their plants because DOE's methods were significantly different from those that may be used for Rancho Seco or other plants. Also, Shippingport was much smaller and less radioactively contaminated than other plants. In this regard, DOE removed the most highly radioactive component, the reactor pressure vessel, in one piece. Utilities operating commercial plants will probably have to disassemble (cut up) the reactor pressure vessels because of their much larger size. Also, DOE disposed of all the radioactive waste from Shippingport at its Hanford, Washington, facility. Utilities will have to dispose of waste at commercial sites at substantially higher costs.

A DOE research effort at Rancho Seco could increase the information available to utilities, especially if it includes cutting up the pressure vessel. However, the additional information gained should be weighed against the federal government's research costs, particularly since many years may elapse before utilities start to decommission a large number of plants and the results of ongoing international decommissioning and research activities may override Rancho Seco's results.

Overview of the Shippingport Project

Shippingport, a 72-megawatt pressurized water reactor,[2] was smaller than plants built during the 1960s and 1970s. The plant was constructed during the mid-1950s as a joint project between DOE and the Duquesne Light Company and operated from December 1957 to October 1982. Under the contract, DOE owned the reactor and steam-generating portions of the plant while the utility owned the electricity-generating portion. According to DOE, the contract also required DOE to return the site to safe conditions on or before 1994. Accordingly, DOE removed and disposed of the fuel, decommissioned the plant at the end of its useful life, and disposed of all waste generated from the decommissioning activities. DOE disposed of about 216,000 cubic feet of radioactive or mixed waste at its Hanford, Washington, site and sent the spent (used) fuel to its Idaho National Engineering Laboratory. Presently, no disposal site exists for the spent fuel from commercial plants; DOE expects that the earliest a permanent site would be available is 2010. In addition, DOE removed the reactor pressure vessel intact and shipped it by barge to Hanford for disposal.

[2]Pressurized water reactors are those cooled by water that is kept at high pressure to prevent it from boiling. The water passes through the nuclear fuel to a secondary system where steam is produced.

Lessons Learned From Decommissioning Shippingport

In September 1985, DOE began the physical decommissioning of Shippingport. DOE completed these activities in July 1989, including dismantlement of the nonradioactive structures; certified in October 1989 that the site was radiologically safe; and issued a final report on the project in December 1989.[1] The cost for these activities was $91.3 million, compared with the $98.3 million originally estimated.

According to the December 1989 report, Shippingport provided useful information to the commercial nuclear industry in a number of areas. Some of the benefits cited in the report were that (1) a nuclear plant can be decommissioned within the costs and time frames established, (2) equipment and technology exist to decommission a nuclear plant, and (3) strict management attention to planning can lead to reduced occupational exposures and efficient removal of radioactively contaminated components. However, a number of uncertainties exist concerning the overall usefulness of DOE's information. For example, we noted that only about 30 percent of DOE's costs related to physical decommissioning activities; the remaining 70 percent included oversight, management, and other activities. Utilities, faced with setting aside funds to decommission their plants and subject to scrutiny by public service commissions when doing so, most likely could not incur the high level of oversight and management costs that Shippingport involved.

Differences Between Shippingport and Rancho Seco

Some significant differences exist between Shippingport and Rancho Seco. Shippingport was a 72-megawatt plant; Rancho Seco is a 913-megawatt plant, a more typical size for a commercial plant. Shippingport was not licensed by NRC; Rancho Seco received a license in 1974. Shippingport operated for about 80,325 hours and produced about 7.4-billion kilowatt-hours of electricity; Rancho Seco operated for about 51,595 hours and produced about 44-billion kilowatt-hours of electricity. Since extensive decontamination activities were conducted over the life of the plant, Shippingport—including the reactor pressure vessel[2] —was more radiologically clean than would be expected for a plant such as Rancho Seco. Shippingport's pressure vessel contained over 30,000 curies[3] of radioactivity at the time the reactor was shut down while Rancho Seco's is estimated to be around 1-million curies.

[1] Final Project Report Shippingport Station Decommissioning Project, Dec. 22, 1989

[2] Generally, reactor vessels are large, steel cylindrical vessels that can weigh almost 1,000 tons and vary from about 45 to 70 feet in height. The walls of the vessels range from about 7- to 11 inches thick. Shippingport's vessel weighed about 153 tons and was about 25 feet high.

[3] A curie is a measure of the rate of radioactive decay.

In addition, according to DOE officials, Shippingport did not generate any of the most highly radioactive low-level waste that can remain hazardous for a few hundred to tens of thousands of years (greater than Class C).[1] SMUD officials said that decommissioning Rancho Seco will generate such waste. Although these officials believe that the amount could be considerable, they could not estimate the volume. The company is now developing this and other information related to the amount of radioactivity in the plant.

Research Issues Not Addressed

Shippingport left unanswered a number of questions concerning the decommissioning of large commercial nuclear power plants.

Pressure Vessel Decommissioning

DOE removed the pressure vessel at Shippingport in one piece. The pressure vessel is the most highly contaminated part of a nuclear power plant. At Shippingport, 99 percent of all radioactivity was contained in the pressure vessel. Although removal of the vessel in one piece minimized worker exposures and costs, DOE's actions did not provide the nuclear industry with information on the problems that may be encountered if utilities must cut up this component. Utilities should derive better information from the cleanup of the Three Mile Island, Pennsylvania, plant.

NRC's Review and Approval

Shippingport was not licensed by NRC; therefore, DOE did not have to obtain NRC's approval for the decommissioning activities conducted at the plant. Under NRC's regulations, a utility must submit a preliminary plan about 5 years before it starts to decommission a plant. The plan should address, among other things, funds that may be needed and the method that will be used to decontaminate all radioactive structures to a level where they can remain on the site without adversely affecting public health and safety in the future.

Although NRC is responsible for ensuring that the utility satisfies the agreed-upon plan, the Environmental Protection Agency (EPA) is ultimately responsible for setting the limits of residual radiation that can

[1] Low-level waste is waste that is not classified as uranium mill tailings, high-level waste, or spent fuel, and consists of discarded tools, rags, machinery, paper, and protective clothing. About 3 percent of such waste—greater than Class C—is contaminated with long-lived radioactive elements having concentrations greater than those specified in 10 CFR Part 61 of NRC's regulations. Presently, no disposal site exists for such waste.

remain on the site. EPA has been developing such standards for several years and expects to make them final no sooner than 1993. NRC will then incorporate EPA's standards into its regulations.

In the absence of EPA standards, DOE required at Shippingport that public exposure from residual contamination should not exceed 100 millirem per person per year.[7] DOE's report on the project indicates that public exposures will not exceed 2 millirem annually. In the absence of EPA's standards, NRC has been suggesting that utilities decontaminate to a level that would limit public exposures to 10 millirem a year—10 times less than DOE required at Shippingport.[8]

Decommissioning Costs

DOE spent $91.3 million to decommission Shippingport. Although little actual data exist on the costs to decommission a large commercial plant, most estimates are in the hundreds of millions of dollars. Some of the difference in costs between Shippingport and commercial plants can be attributed to labor rates, costs for removing the pressure vessel, and waste disposal costs. DOE documents show that it saved about $7 million in decommissioning costs by removing the pressure vessel intact. Utilities may not be able to use this option because of site-specific problems to remove and transport the vessel in one piece. Also, the much higher radioactivity in the pressure vessel may preclude its disposal in a commercial site.

Furthermore, DOE sent all decommissioning waste from Shippingport to its Hanford facility for disposal. Utilities will eventually have to dispose of their waste in commercial sites—at a much higher cost. For example, in 1986, low-level waste disposal costs at Hanford were $3.95 per cubic foot; by 1989 the cost had increased to about $27.60 per cubic foot.[9] Also, after January 1993, low-level waste disposal costs could range from $50 to $590 or more per cubic foot as a result of costly new facilities—possibly as many as 16—that may be built by states or interstate compacts to dispose of low-level waste. Therefore, significant differences exist between DOE's waste disposal costs for Shippingport and those that could be experienced by nuclear utilities.

[7] Rem (Roentgen Equivalent Man) is a measurement used to quantify the effects of radiation on man. A millirem is a thousandth of a rem.

[8] Currently, 11 nuclear plants are shut down. NRC has approved decommissioning plans for 5 of the plants.

[9] The $27.60 does not include packaging, transportation, labor, materials, taxes, or the cubic-foot surcharges allowed by the Low-Level Radioactive Waste Policy Act, as amended.

New Technology Not Used at Shippingport

One objective of the Shippingport project was to demonstrate that a nuclear power plant could be safely and economically decommissioned using existing technology, such as manually dismantling radioactive piping systems and components. Therefore, DOE did not develop any new technology, such as remotely operated equipment, to decommission Shippingport.

NRC projects that the earliest nuclear plant operating license is due to expire in the year 2000, and by the year 2015 about one-half of the 113 operating licenses currently in effect will terminate. Most of the remaining operating licenses will expire by about 2030. However, utilities can apply to NRC to extend the plants' operating licenses. Because of the high cost of building new generating plants—either nuclear or coal—and the increasing demand for electricity, utilities want to keep their existing plants in service for as long as it is safe and economical to do so. In addition, under NRC's regulations, utilities can take as long as 60 years to complete decommissioning activities. Therefore, many years may elapse before utilities dismantle a large number of plants, and new technology may be available at that time.

Issues to Be Considered If DOE Conducts Research at Rancho Seco

Although not all-inclusive, the following sets forth some issues that DOE should consider before funding a research project at Rancho Seco.

- Should DOE wait for the results from international research and other activities before deciding to participate in the decommissioning of Rancho Seco? Presently, the United Kingdom is decommissioning two reactors, and Japan is conducting research on using robotics to dismantle highly radioactive components. These efforts could duplicate or negate the need for research at Rancho Seco.
- If DOE participated in the decommissioning of Rancho Seco through a contractor, would the DOE contractor assume the accident liability coverage of SMUD? The Price-Anderson Act (42 U.S.C. 2210) establishes a mechanism for compensating the public for personal injury or property damage in the event of a nuclear accident. The act provides "umbrella" coverage and limits the liability for anyone (contractors, subcontractors, vendors, suppliers, architect-engineers, and transporters) who performs work in connection with commercial or government nuclear activities. The act prescribes a system of private insurance and government indemnity to cover the off-site consequences of a nuclear accident at commercial and government facilities.
- If, for research purposes, DOE accepts the spent fuel and greater-than-Class C waste from Rancho Seco, would these actions set a precedent for

the industry? Under NRC's regulations, utilities must safely dispose of waste generated during plant operations and from decommissioning activities. Utilities must also ensure that the site meets certain criteria before NRC can terminate the license. Presently, no facility exists to permanently dispose of spent reactor fuel or greater-than-Class C waste.

- Has the Electric Power Research Institute (EPRI) been asked to, or expressed an interest in, conducting research at Rancho Seco? Should the industry take the lead in conducting and funding such an effort? EPRI conducts research in such areas as advanced technology systems, energy analysis, and environmental assessments for its 600 member utilities, which provide about two-thirds of the nation's electricity.

Conclusions

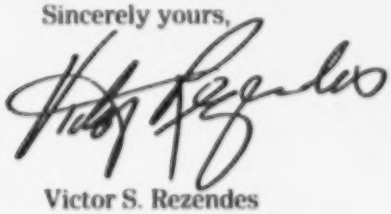
A research effort at Rancho Seco could increase the knowledge needed to decommission nuclear power plants. However, utilities may not decommission a large number of plants until well into the 21st century. Therefore, DOE and the Congress will need to weigh the costs of conducting research at Rancho Seco against the benefits to be derived over the long term.

The information in this report on Shippingport is based on data that we obtained to respond to a July 1989 letter from the Chairman and Ranking Minority Member, House Science, Space, and Technology Committee. We obtained other information through interviews with utility and industry officials and previously issued GAO reports. We discussed the information in this report with DOE and NRC staff and incorporated their views where appropriate. As requested, we did not ask DOE or NRC to review and comment officially on this report. Our work was conducted between January and March 1990 in accordance with generally accepted government auditing standards.

As agreed with your office, we are sending copies of this report today to the House Committee on Science, Space, and Technology. We will also make copies available to the Secretary, Department of Energy; the Chairman, Nuclear Regulatory Commission; and others upon request.

Please call me at (202) 275-1441 if you have any questions. Major contributors are listed in appendix I.

Sincerely yours,



Victor S. Rezendes
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